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Dynamics Shaking Total Factor Productivity in Manufacturing Sector of Pakistan: A Panel Data Analysis

Samara Haroon, Dong Hui Zhang*
School of Economics, Shandong University, Jinan, PR China
*Email. zdh@sdu.edu.cn
Tel.: +8613708926062

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Abstract

This research article investigates how explanatory variables are responsible for change in total factor productivity in manufacturing sector of Pakistan. Panel data of selected fifteen manufacturing firms of Pakistan from 2005 to 2013 are used to capture time and space affects. Considering data set of fifteen selected manufacturing firms consistently, it was found that explanatory variables (like size of firm, leverage, cash flows and Ownership) were responsible for changed in TFP growth. Empirical results suggest that explanatory variables appear to be most dominating factors in order to influence the TFP growth over a period of time and over a firm also. Research study further will provide a guide for Pakistan policy makers to set priorities to improve TFP growth for their manufacturing firms especially in Punjab.

Keywords: Total Factor Productivity, Manufacturing Sector, Punjab, Pakistan

Introduction

TFP growth sets opportunity towards society to increase the welfare of people by increasing the production of manufacturing sector. Further productive efficiency plays an important role in economic planning and development. It is core objectives of any government to enhance the overall growth and development of the economy in order to enhance the GDP. Now the world has become a global village and becoming more competitive and challenging, so in order to maintain economic competitiveness, a government has to maintain its productivity to make the economic conditions a center of attraction of investment from local investors, international investors, specialized working conditions and technologies which are important for optimizing economic growth. Pakistan is developing economy that is why total factor productivity is one of the important factor for the policy makers in order to make good decisions which may lead to transform the economy into industrial based economy. The debate over productivity has taken place in all the disciplines which have a concerned with the issues of daily life. This demand of higher productivity give raises the competitive environment in which businesses and firms are always in a search of places where they get a benefit of minimum investment in response to maximum output. In literature there are a different concepts of productivity like Labor Productivity, Capital Productivity and more importantly the Total Factor Productivity. “Total factor productivity (TFP) is the portion of output not explained by the amount of inputs used in production” (Comin, 2006). Another researcher said that TFP is a great source to measure productivity independently from the capital and labor by considering the other factors which have a direct or indirect relationship with the TFP of any sector or overall industries (Edmond, 2008). As TFP is a prominent source of manufacturing sector performance measurement, but it has some different aspects. Some studies only check the impact of financial development (Arizala, Cavallo, & Galindo, 2013), some just size of firms (Leung, Meh, & Terajima, 2008), some

technological changes etc. It states that TFP is a good indictor to measures growth in manufacturing firms. The manufacturing sector is the major contributor on the progress of any country economic growth and capturing 63 percent share of the industrial sector but this sector is suffered due to continuous power breakdown, law & order situation and terrorism activities (Finance, 2012-13).

It is up to the managers to categorize productivity problems and develop a suitable program to answer the problems. In the past several years, several of the Nation's most successful, larger corporations have happening Productivity Improvement Programs (PIP). Total factor productivity can be estimated by a number of explanatory variables like firm sizes, skill based technologies, productive and non-productive labor, education, capital (Donghyun et al, 2014). Know the question is what are the appropriate factors that have positive/negative impact on TFP? There is a space which needs to be filled, especially in manufacturing sector of Pakistan.

Theoretical and empirical literature that covers the subject matter in the light of previously published work is presented here. Tinbergen, (1942) firstly defined the TFP as the ratio between actual product and actual factor inputs. Afzal in 2006 has estimated the total factor productivity by studying the three different approaches which are classical models, Simultaneous equation approach and autoregressive models on large scale manufacturing sector of Pakistan. The researcher found that productivity of manufacturing sector was badly affected with the variables like gross national product, labor and capital and if these variables are properly utilized then might left positive impact on the large scale manufacturing sector of Pakistan. By using TFP approach, Schor in 2004 measures the performance of the small and medium Spanish manufacturing firms during 1995-2001 and found that small and medium firms were more efficient than large firms. Yang (2009) have studied the China and stated that high economic growth is due to productivity growth and this productivity growth is due to China's dedicated efforts to innovative activities and R&D. The researcher also found that results disclosed the differences in productivity growth between the coastal & non-coastal regions.

Methodology

For this research secondary data is used, the main focus of this research is to examine the productivity of selected manufacturing firms in Pakistan (Firm names are provided in table 1).

Table 1. Selected manufacturing firms from Pakistan

List of Firms	
1. Atlas Honda	9. Fauji Cement
2. Attock Cement	10. Gul Ahmed
3. Nishat Mills	11. DG Khan Cement
4. Pakistan Cables	12. Pioneer Cement
5. Sitara Chemicals	13. Indus Motors
6. Kohinoor Textile	14. Bestway Cement
7. Lucky Cement	15. Baluchistan Wheels
8. Bannu Wollen	

The observed data will be time series as well as cross section which is converted to Panel data. The data set was considered from 15 selected manufacturing firms (n) for the period (T) 2005 to 2013, which is converted to panel data so total number of observations is 135 as $n \times T = 9 \times 15 = 135$. When we say panel data then data must be well arranged by both time series and cross sectional variables, so that we can get a strong impression of presence of random and/or fixed effects.

Table 2 Descriptive statistic/Summary of data

Variable	Mean	Std. Dev.	Minimum	Maximum	Obs.
TFP	-20.4807	32.9136	-100.1	6.8	135
OS	.3185	.4676	0	1	135
SOF	1808190	3821943	593	2.14e+07	135
LEV	2.2187	6.7401	.04	36.3	135
CF	502230.6	301820	69034	997391	135

Some of the observations were missing that have been attained by interpolation technique because missing values lower the quality of panel data. Table 2 provides the summery statistics of included variables which belongs to fifteen selected manufacturing firms from Pakistan. The mean for TFP growth which is proxy for firm growth is -20.4807 and standard deviation (32.9136).

First we construct the production function framework that reflect the production of firm and will help to find TFP. Suppose variables factor of production (labor and capital) only determine the output level in any firm, and the model can be written as.

$$Q = f(L, K) \text{ --- (a)}$$

Here, Q is output and L is labor and K is capital used in production process. Above equation by using non-linear Cobb-Douglas model can be written as:

$$Q = AL^{\alpha}K^{\beta} \text{ --- (b)}$$

Here A is TFP (total factor productivity) representing other responsible factors for production except labor and capital. For measuring TFP equation (b) can be converted to linear after taking logarithm and arranging for all individual firms we can find TFP. After finding the TFP, the extended model for our research study can be written as:

$TFP_{it} = f(OS_{it}, SOF_{it}, LEV_{it}, CF_{it})$ …(i)

Where

TFP	Total Factor Productivity
OS	Ownership
SOF	Size of firm
LEV	Leverage
CF	Cash flows

Here, i show firm effects in explanatory variables, and t shows time effects in explanatory variables and the assumptions of U_{it} is that$U_{it} \approx IID(0, \sigma_u^2)$, i.e. errors are independently identically distributed with zero mean and stable variances. Where i denote a specific firm and t denotes a specific time period. The methodology is further divided into four parts as: First: Group effects while keeping all coefficients are constant across time and firms, Second: Intercept varies across firms but slope coefficient constant, Third: Intercept varies across firms as well as time with constant slope coefficient, Fourth: all coefficients vary across firms.

Results and Discussion

After conducting a panel data analysis and choosing the best model between FEM and REM, Hausman test is used, which has favored FEM (Fixed Effect Model), detailed test results are shown in table 3. The results are distributed further in four sections.

Table 3. Hausman test results for all models

Sr. #:	Model	Hausman test Value	Significant or not Sig.
1	Model-3a	0.000	Significant
2	Model-3b	0.000	Significant
3	Model-3c	0.010	Significant
4	Model-4a	0.001	Significant
5	Model-4b	0.000	Significant
6	Model-4c	0.024	Significant
7	Model-5a	0.000	Significant

If Hausman test value <0.05 then statistically significant.

The Hausman test will generate significant results if its value is less than 0.05. Hence, Hausman test favors in all models for FEM (Fixed Effect Model).

Group Effects while keeping All Coefficients are Constant across Time and Firms

The results are presented in table 4. It is concluded that we cannot reject the null hypothesis that explanatory variables does not explain TFP growth and selected determinants considered enough in order to explain the TFP growth. Pooled OLS model-1a fits the data very well and is significant at the 1 percent. Adjusted R2 is .18 means that Model-1a accounts for 18 percent variations in the FTP growth for fifteen selected firms. In Model-1a, in case of zero cash flows and zero ownership for each firm (fifteen selected firms) is expected to have -38.3384 TFP growth (p<.0000). Considering the data for all fifteen selected firms the signs of cash flows co-efficient are consistently positive across specifications and in all models it is statistically significant. This also shows the stability of the model since by adding more explanatory variables the sign and significance of cash flows does not change. The coefficients of cash flows and ownership are also statistically significant in all specification cases and have positive effect on TFP growth.

Table 4.Regression results with Pooled OLS and Fixed Effect Model for period 2005-2013. DV is TFP.

	Model-1a (OLS)	Model-1b (OLS)	Model-1c (OLS)
CF	.000019**	.000018*	.0000177*
OS	25.9926***	26.0960***	25.5853***
SOF		0.990947	0.898929
LEV			.0883
Intercept	-38.3384***	-36.6525***	-36.8877***
F Test	14.82***	9.99***	7.45***
Adj. R^2	.1833	.1861	.1864
Obs.	135	135	135

***, **, and * denote significance level at 1%, 5% and 10% respectively.

Intercept Varies Across Firms but Slope Coefficient Constant

After conducting the Fixed Effect Model (FEM) with the technique of Least Square Dummy Variables (LSDV) to check the exact nature of relationship between TFP and its determinants like as size of firm, leverage, cash flows and Ownership (Foreign or domestic firm) are presented in three models from Model-2a to Model-2c in table 5. The models have differences that are based on the set of explanatory variables used in the model. Here we have examined the fixed group effects by intro-

ducing group (firm) dummy variables so that we may be able to differentiate between firm specific or unique effects. The dummy variable f1 is set for Atlas Honda and zero for other firms. Similarly other dummies represent the other fourteen firms respectively. For preventing from dummy variable trap, only fourteen dummies have been used. Estimated coefficients for Cash flows, ownership, size of firm and leverage are individually significant as p value of estimated coefficients is very small. LSDV fits the data very well as Adjusted R^2 increases in Model-2a to Model-2c. The fixed effect model posits that each firm has its own intercepts but share the same slopes of explanatory variables.

Table 5. Regression results for panel study with Fixed Effect Model.

	Model-2a (Fixed Effect)	Model-2b (Fixed Effect)	Model-2c (Fixed Effect)
CF	-.6229	-2.90e-07	-2.89e-070
OS	-2.33e-07	-.0705	-.4704*
SOF		-3.77e-08*	-3.77e-08
LEV			.00179
Firm 2	2.3152***	2.7361***	2.4371***
Firm 3	-10.9365***	-10.7926***	-10.7919***
Firm 4	11.8163***	11.9655***	11.9648***
Firm 5	-7.1694***	-6.7725***	-6.7729***
Firm 6	-82.1821***	-81.7719***	-81.7714***
Firm 7	-2.5002***	-2.3576***	-2.3569***
Firm 8	-94.2022***	-94.0776***	-94.0765***
Firm 9	11.8528***	12.1233***	12.1238***
Firm 10	-18.6688***	-18.5466***	-18.5464***
Firm 11	-54.4412***	-54.3217***	-54.3208***
Firm 12	3.8147***	4.1163***	4.1167***
Firm 13	4.2916***	4.3075***	4.3079***
Firm 14	9.5438***	9.5173***	9.5175***
Firm 15	4.2773***	4.2525***	4.2065***
Intercept(baseline) for Atlas Honda	-5.3529***	-5.4557***	-5.4573***
F Test	34724.07***	33339.49***	31129.67***
Adj. R^2	.99	.99	.99
Obs.	135	135	135

***, **, & * denote significance level at 1%, 5% and 10% respectively.

Intercept Varies across Firms as well as Time with Constant Slope Coefficient

Results are presented in table 6, all three models include dummy variables that accounts for individual firm effects. Same as we can allow the time effects in the sense that TFP growth has been shift over a period of time, for this purpose time dummies are introduced in which case we have taken 2005 as a base year and from the period of 09 years we have only introduced 08 time dummies (to prevent from dummy variable trap). The sign and statistical significance of coefficients for explanatory variables are almost same. Model-3a to Model-3c show that cash flows, ownership, size of firm and leverage selected from fifteen firms from Pakistan. The results presented in Model-3c appear to be more robust and have higher value of adjusted R2and since it makes the prediction that

99% variances in TFP growth are explained by studied explanatory variables, country dummies and time dummies regressors. In table 6, in all three models include dummy variables that accounts for individual firm effects. Same as we can allow the time effects in the sense that TFP growth has been shift over a period of time, for this purpose time dummies are introduced in which case we have taken 2005 as a base year and from the period of 9 years we have only introduced 8 time dummies.

In all three models, individual time dummies were individually statistically significant which suggest that TFP growth have changed not much over a time period. Here, also some of the individual firm effects were also statistically significant. In other words, the TFP growth functions for fifteen selected firms have changed due to explanatory variables effects, individual country effects and as well as time period effects.

Table 6. Fixed effect results during period 2005-2013.

	Model-3a (Fixed Effect)	Model-3b (Fixed Effect)	Model-3c (Fixed Effect)
CF	-3.61e-07*	-4.09e-07*	-4.06e-07*
OS	-.5036	-.3604	-.3647
SOF		-3.37e-07*	-3.38e-08*
LEV			.00756
Firm 2	2.3636***	2.4877***	2.4799***
Firm 3	-10.8370***	-10.7010***	-10.7024***
Firm 4	11.9265***	12.0662***	12.0628***
Firm 5	-7.1125***	-6.7504***	-6.7523***
Firm 6	-82.1199***	-81.7454***	-81.7469***
Firm 7	-2.4052***	-2.2703***	-2.2721***
Firm 8	-94.1450***	-94.0254***	-94.0253***
Firm 9	11.9158***	12.1655***	12.1641***
Firm 10	-18.6177***	-18.5001***	-18.5038***
Firm 11	-54.3993***	-54.2840***	-54.2848***
Firm 12	3.7517***	4.0234***	4.0261***
Firm 13	4.3016***	4.3167***	4.3178***
Firm 14	9.4823***	9.4598***	9.4611***
Firm 15	4.2219***	4.2008***	4.0072***
Dummy for 2006	.1177	.0889	.0885
Dummy for 2007	-.3603*	-.3681*	-.3679*
Dummy for 2008	-.3402/	-.3370*	-.3334*
Dummy for 2009	-.2865	-.3109	-.3051
Dummy for 2010	-.2676	-.2440	-.2381
Dummy for 2011	-.0436	-.0528	-.0469
Dummy for 2012	-.0314	-.0379	-.0290
Dummy for 2013	.1572	.1529	.1625
Intercept(combined)	-5.2437***	-5.3387***	-5.3461***
F Test	25386.64***	24775.66***	23626.39***
Adj. R^2	.99	.99	.99
Obs.	135	135	135

***, **, & * denote significance level at 1%, 5% and 10% respectively.

All Coefficients Vary Across Firms

Table 7 presents the estimated TFP growth where all the studied coefficients vary across firms. TFP growth is significantly related to leverage and ownership. However, some of the differential slope coefficients are also statistically significant. In short, we can say that the explanatory variables introduced in the model influences the TFP growth rate for selected fifteen firms. The relationship between TFP growth and other explanatory variables have mix nature, some firms have positive and some firms have negative slope differential intercepts which presents different values which also shows the effects of management of the respective firms.

Table 7. Results for Fixed Effects for period 2005-2013.

	Model-4a (Fixed Effect)
CF	.2836
OS	-2.54e-06
SOF	-2.13e-07*
LEV	.12643*
Firm 2	-3.5448***
Firm 3	-16.6733*
Firm 4	6.3062***
Firm 5	-12.7966***
Firm 6	-86.0081***
Firm 7	-7.9681***
Firm 8	-99.9607***
Firm 9	6.3367**
Firm 10	-24.4849***
Firm 11	-56.3692***
Firm 12	-2.0007
Firm 13	-2.9138
Firm 14	2.2620
Firm 15	1.3254*
F2CF(Atlas Honda)	2.22e-06
F3 CF (Attock Cement)	2.45e-06
F4 CF (Nishat Mills)	2.37e-06
F5 CF (Pakistan Cables)	2.46e-46
F6 CF (Sitara Chemical)	2.54e-07
F7 CF (Kohinoor Textile)	1.80e-07
F8 CF (Lucky Cement)	2.23e-06
F9 CF (Bannu Wollen)	1.80e-06
F10 CF (Fauji Cement)	2.50e-06
F11 CF (Gull Ahmed)	2.14e-06
F12 CF (D.G Khan Cement)	-2.04e-06
F13 CF (Poineer Cement)	-1.98e-06
F14 CF (Indus Motors)	3.35e-06
F15 CF (BestWay Cement)	1.90e-06
F2OS(Atlas Honda)	-6.3733
F3OS(Attock Cement)	-5.3214

F4OS(Nishat Mills)	-4.3250
F5OS(Pakistan Cables)	-7.1245
F6OS(Sitara Chemical)	4.2541
F7OS(Kohinoor Textile)	1.2463
F8OS(Lucky Cement)	1.2748
F9OS(Bannu Wollen)	8.6542
F10OS(Fauji Cement)	3.1348
F11OS(Gull Ahmed)	-4.3152
F12OS(D.G Khan Cement)	-1.2154
F13OS(Poineer Cement)	3.1248
F14OS(Indus Motors)	3.2514
F15OS(BestWay Cement)	3.2367
F2SOF(Atlas Honda)	-.0000134
F3 SOF (Attock Cement)	.0000106
F4 SOF (Nishat Mills)	-7.66e-06
F5 SOF (Pakistan Cables)	-.0000743
F6 SOF (Sitara Chemical)	4.54e-09
F7 SOF (Kohinoor Textile)	-.0000128
F8 SOF (Lucky Cement)	-.0000214
F9 SOF (Bannu Wollen)	.0000598
F10 SOF (Fauji Cement)	-2.23e-06
F11 SOF (Gull Ahmed)	-.0000175
F12 SOF (D.G Khan Cement)	-.0000326
F13 SOF (Poineer Cement)	-2.04e-06
F14 SOF (Indus Motors)	9.52e-06
F15 SOF (BestWay Cement)	-.0014886
F2LEV(Atlas Honda)	-.05946
F3 LEV (Attock Cement)	.45076
F4 LEV (Nishat Mills)	.2176
F5 LEV (Pakistan Cables)	.05125
F6 LEV (Sitara Chemical)	-.2238
F7 LEV (Kohinoor Textile)	4.8565
F8 LEV (Lucky Cement)	.7476
F9 LEV (Bannu Wollen)	1.0565
F10 LEV (Fauji Cement)	-.3261
F11 LEV (Gull Ahmed)	.5132
F12 LEV (D.G Khan Cement)	-2.7735
F13v(Poineer Cement)	4.0911
F14 LEV (Indus Motors)	.1306
F15 LEV (BestWay Cement)	-.02585
Intercept (combine)	.3191*
F Test	8552.34
Adj. R^2	.99
Obs.	135

***, **, and * denote significance level at 1%, 5% and 10% respectively.

Conclusion

Conclusion recaps the overall findings of the research; we have used a panel data of fifteen selected firms from Pakistan to capture in time and space effects of explanatory variables on TFP growth. Considering our data set of fifteen selected firms between 2005 and 2013 periods, we have consistently found that explanatory variables have changed the TFP growth over the period of time as well as firms also. Empirical results suggest that explanatory variables appear to be most dominating factors in order to influence the TFP growth. Research study first presents the importance of TFP growth phenomenon as we saw the TFP is very heatedly discussed in national as well as international level. The lower TFP growth is largely due to deviations of cash flows in many of the studied firms in Pakistan which might be the consequence of lack of good governance, poor law and order, corruption and frequent change in firm management which are some common characteristics of the firms from Pakistan. It is also shown that there is no any firm maintaining the high TFP growth and sustained profits, where firm decision makers would be agreed in promoting the organizational performance and financial performance of the respective firm.

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